Ammonia from Air;
$SmMn_2O_5$ as novel catalytic phase for NO_3 reduction

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Thanks to the invention of the Haber-Bosch process in 1909, we can produce ammonia industrially.[1,2] While this is great, it comes at a cost: it consumes 1-2% of the world's energy and relies *heavily* on fossil fuels. Our goal is to develop an alternative zero-emission process that produces ammonia from air, water and electricity.

Instead of reduction, we are taking the opposite approach: using *oxidation* to fix nitrogen from the air. This is a two-step process: First, a plasma reactor produces nitrogen oxides (NO_x). Here, we use gas-solid catalysts to boost efficiency and selectivity.[3] This does the heavy lifting of breaking the strong N≡N bond, producing oxidized nitrogen (NO_x). Then, we absorb these NO_x molecules in water and reduce them to ammonia by electro-catalytic reduction.[4] Producing NO_x with plasma was developed over a century ago (the Birkeland-Eyde process), but was abandoned because of its low efficiency. Our strategy is to bring *catalysis* into this process so we can increase the output of NO_x and improve efficiency.

Oxidizing nitrogen generates all kinds of NO_x species (NO, NO_2, N_2O). To capture and reduce the NO_x on site, we are building a separate electrolyzer prototype with electrocatalysts will be developed with a focus on performance under realistic practical conditions. We will share our latest results on a novel samarium-based nitrogen reduction catalyst, which shows promising NO_3 reduction activity and stability. Hopefully, this will lead to a self-contained unit that generates "green" ammonia catalytically, using nothing but electricity, water and air.[5]

This research is supported by an Azrieli Fellowship and The Israel Academy of Science and Humanities.

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